**WE CLAIM:**

Sub a2

1. A very narrow band two chamber high repetition rate gas discharge laser system with special timing control features, said system comprising:

A) a first laser unit comprising:

1) a first discharge chamber containing;

a) a first laser gas

b) a first pair of elongated spaced apart electrodes defining a first discharge region,

2) a first fan for producing sufficient gas velocities of said first laser gas in said first discharge region to clear from said first discharge region, following each pulse, substantially all discharge produced ions prior to a next pulse when operating at a repetition rate in the range of 4,000 pulses per second or greater,

3) a first heat exchanger system capable of removing at least 16 kw of heat energy from said first laser gas,

4) a line narrowing unit for narrowing spectral bandwidths of light pulses produced in said first discharge chamber,

B) a second laser unit comprising:

1) a second discharge chamber containing:

a) a second laser gas,

b) a second pair of elongated spaced apart electrodes defining a second discharge region

2) a second fan for producing sufficient gas velocities of said second laser gas in said second discharge region to clear from said second discharge region, following each pulse, substantially all discharge produced ions prior to a next pulse when operating at

a repetition rate in the range of 4,000 pulses per second or greater,

3) a second heat exchanger system capable of removing at least 16 kw of heat energy from said second laser gas,

C) a pulse power system configured to provide electrical pulses to said first pair of electrodes and to said second pair of electrodes sufficient to produce laser pulses at rates of about 4,000 pulses per second with precisely controlled pulse energies in excess of about 5 mJ,

D) a laser beam measurement and control system for measuring pulse energy, wavelength and bandwidth of laser output pulses produced by said two chamber laser system and controlling said laser output pulses in a feedback control arrangement, and

E) a processor programmed with an algorithm providing feedback timing control.



a2 cont.

2. A laser system as in Claim 1 wherein said first laser unit is configured as a master oscillator and said second laser unit is configured as a power amplifier.

3. A laser system as in Claim 2 wherein said laser gas comprises argon, fluoride and neon.

4. A laser system as in Claim 2 wherein said laser gas comprises krypton, fluorine and neon.

5. A laser system as in Claim 2 wherein said laser gas comprises fluorine and a buffer gas chosen from a group consisting of neon, helium or a mixture of neon and helium.

6. A laser as in Claim 1 wherein said first fan and said second fan each are tangential fans and each comprises a shaft driven by two brushless DC motors.

7. A laser as in Claim 15 wherein said motors are water cooled motors.

8. A laser as in Claim 1 wherein said pulse power power system comprise water cooled electrical components.

9. A laser as in Claim 8 wherein at least one of said water cooled components is a component operated at high voltages in excess of 12,000 volts.

10. A laser as in Claim 9 wherein said high voltage is isolated from ground using an inductor through which cooling water flows.

11. A laser as in Claim 1 wherein said pulse power system comprises a resonant charging system to charge a charging capacitor to a precisely controlled voltage.

C2 cont.

12. A laser system as in Claim 1 wherein said system is configured to operate either of a KrF laser system, an ArF laser system or an $F_2$ laser system with minor modifications.

13. A laser system as in Claim 1 wherein substantially all components are contained in a laser enclosure but said system comprises an AC/DC module physically separate from the enclosure.

14. A laser system as in Claim 1 wherein said pulse power system comprises a master oscillator charging capacitor bank and a power amplifier charging capacitor bank and a resonant charger configured to charge both charging capacitor banks in parallel.

15. A laser as in Claim 14 wherein said pulse power system comprises a power supply configured to furnish at least 2000V supply to said resonant charges.

16. A laser as in Claim 1 and further comprising a gas control system for controlling $F_2$ concentrations in said first laser gas to control master oscillator beam parameters.

17. A laser as in Claim 1 and further comprising a gas control system for controlling laser gas pressure in said first laser gas to control master oscillator beam parameters.

18. A laser as in Claim 2 and further comprising a discharge timing controller for triggering discharges in said power amplifier to occur between 20 and 60 ns after discharges in said master oscillator.

19. A laser as in Claim 2 and further comprising a discharge controller programmed to cause in some circumstances discharges so timed to avoid any significant output pulse energy.

20. A laser as in Claim 19 wherein said controller is programmed to cause discharge, in some circumstances, in said power amplifier at least 20 ns prior to discharge in said master oscillator.

21. A laser as in Claim 19 wherein said controller is programmed to cause discharge, in some circumstances, in said power amplifier at least 70 ns after discharge in said master oscillator discharge.

22. A laser as in Claim 20 wherein said at least 20 ns is about 40 ns.

23. A laser as in Claim 21 wherein said at least 70 ns is about 110 ns.

24. A laser as in Claim 1 wherein said laser also comprises P-cells for measuring ASE of discharge in each of said first and second chamber.

25. A laser as in Claim 24 wherein signals from said P-cells wherein said controller is programmed to use signals from said P-cells to indicate discharges.

26. A laser as in Claim 21 wherein said controller is programmed to determine discharges based on measurement of capacitor voltage.

A2 cont.

27. A process for controlling discharge timing of a burst of pulses produced by a MOPA laser system comprising the steps determining the timing of discharges to produce said pulses based on feedback discharge timing signal wherein at least a first set of discharges at start of said burst of pulses are programmed to occur at relative times so that no significant lasing results as a consequence of the discharge.